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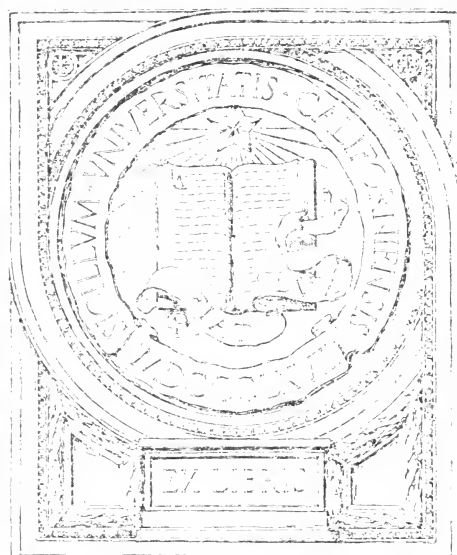
Injuries to Forests and  
Forest Products by  
Roundheaded Borers.  
J. L. Webb

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INJURIES TO FORESTS AND FOREST PRODUCTS  
BY ROUNDHEADED BORERS.

By

J. L. WEBB,

*Agent and Expert, Forest Insect Investigations, Bureau of Entomology.*

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[FROM YEARBOOK OF DEPARTMENT OF AGRICULTURE FOR 1910.]

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# INJURIES TO FORESTS AND FOREST PRODUCTS BY ROUNDHEADED BORERS.

By J. L. WEBB,

*Agent and Expert, Forest Insect Investigations, Bureau of Entomology.*

## FOREST INSECT DEPREDACTIONS.

In recent years much stress has been laid upon the conservation of natural resources in the United States. Of these resources, the forests have probably absorbed more attention than any other. Vast areas have been set aside from the public domain as National Forests in order that the timber supply of the country shall not become exhausted. Much has been said on the subject of damage by fire to the forests, and it is fully realized that this is an ever-present danger. But a more insidious and equally relentless foe of the forests is found in the form of insects which work terrible destruction, often unnoticed until the damage is done. The immense destruction to living forests by certain scolytid barkbeetles, as well as the injurious work of flat-headed borers, have been given attention in former Yearbook articles. In this article another group containing many injurious species is discussed, namely, roundheaded borers. The information conveyed in this paper is based almost entirely on the material and records of the forest insect collection of the Bureau of Entomology.

## ROUNDHEADED BORERS.

Roundheaded borers are so called to distinguish them from the flat-headed borers.<sup>1</sup> The general appearance is that of an elongate, fleshy, yellowish-white grub, sometimes bearing three pairs of legs and sometimes without legs. The head is more or less oval in shape, though sometimes elongate, and often deeply retracted within the first prothoracic segment, which is situated immediately behind the head. The head is provided with a strong pair of jaws or mandibles, brown or black in color, for cutting through plant tissue. Some species mine only in the bark of trees, some mine in both bark and wood, and some confine themselves to herbaceous plants. In each case the borer is hatched from an egg laid upon or in the bark or

<sup>1</sup> See "Injuries to forest trees by flat-headed borers," Yearbook, 1909, p. 399.

wood by the parent beetle. It lives and feeds entirely within the bark or wood until it attains its full growth, when it changes to the pupa, or resting stage, within its burrow. The pupa later transforms to a beetle, which emerges and flies in search of suitable places to repeat the process of propagating the species. In nearly every instance the entire damage is done while the insect is in the grub, or borer, stage. This form is therefore the most important from an economic standpoint.

#### ECONOMIC IMPORTANCE.

Some species of roundheaded borers kill trees outright by mining in the bark, thus destroying the vitality of the tree, while others injure the wood of dead, dying, or felled trees, or timbers manufactured from such trees. Still others both kill the trees and injure the wood for commercial purposes. The annual loss to owners of forest trees and forest products from this source, if figured up in dollars and cents, would amount to a sum far in excess of what the ordinary individual would think possible.

#### CHARACTER OF WORK.

The work of this class of insects usually appears as irregular winding mines or "wormholes" in the bark and wood. The mine always starts in the bark, where the minute larva just hatched from the egg starts to bore and feed. At first the mine is very small, but gradually becomes larger as the borer advances and grows in size. As already indicated, the work of some species is confined entirely to the bark. The work of other species is found in both bark and wood. In this case the mine is continuous from bark to wood, the entrance into the wood being a flattened oval hole. That part of the mine which is in the wood may be long or short, according to the species. In general it is more or less winding and irregular, contains borings and woody excrement, and finally broadens out into a cell or "pupal chamber." At the farther end of this cell the mine, or "exit burrow" as it now becomes, usually leads directly to the surface by the shortest route. Upon the surface it usually appears as a perfectly round "exit hole" (fig. 21, *d*).

#### LIFE HISTORY AND HABITS.

As a usual thing the adult female beetle lays an egg or a cluster of eggs either in or upon the bark in the spring, summer, or early fall. Sometimes the parent female excavates a pit in the bark with her mandibles, through which the eggs are thrust by means of the ovipositor. In other cases eggs may be deposited in crevices of the bark or under the overlapping scales of bark. In a few days after the egg is

deposited a minute wormlike larva (fig. 19, *c*) issues therefrom and immediately begins boring into the bark with which it finds itself in contact. The larva usually proceeds directly to the inner bark, or cambium, immediately next to the wood. Here the larva mines and feeds until it reaches a certain growth, when it makes preparation for a change called pupation. The entire growth of the insect is attained in the larval form.

Usually, before it attains full growth, however, the larva mines either into the solid wood or into the outer corky bark and digs out an elongate oval cell, in which it will soon pupate. From the farther end of the pupal cell the larva, as a general thing, extends the mine almost to the surface of the tree or log, in order to facilitate its emergence into the open air when it has gone through its changes in the pupal cell to the adult or beetle form. This work completed, it retires to the pupal cell and awaits the change to the pupal form. Finally the outer skin comes off and the insect has an entirely different form and appearance (fig. 20, *d*). It is now a pupa. The length of time passed in this form is variable with the

species and with the local conditions, the pupa resting perfectly quiescent in its cell during this period. At length another change takes place and the insect is in the adult or beetle stage (fig. 20, *b*). At first the beetle retains the white color of the pupa and larva, and the outer tissue of the body is quite soft. But gradually the color turns darker and the outer tissue becomes hard and chitinous. When

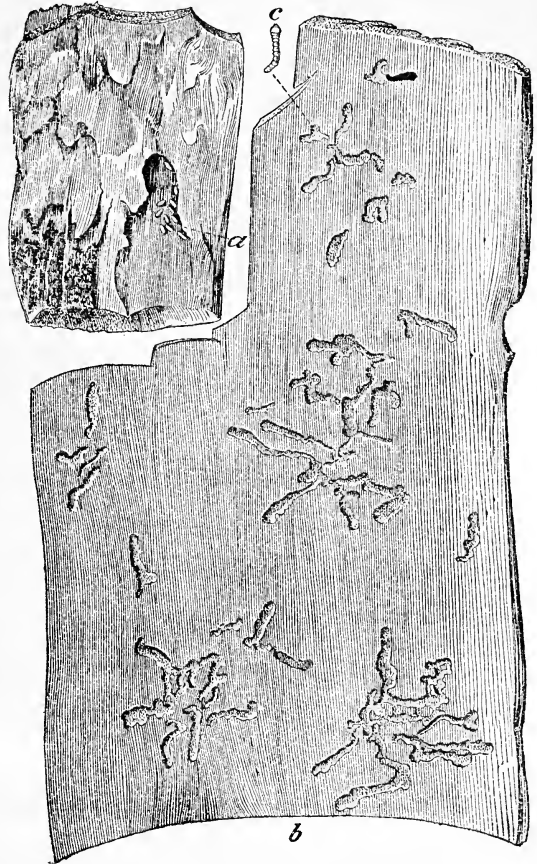


FIG. 19.—Work of the western larch bark-borer (*Tetropium velutinum*). Sections of bark of western larch: *a*, Cluster of eggs deposited under overlapping scale of outer bark, the overlapping scale, in this instance, having been removed; *b*, Inner surface of bark with newly started mines; *c*, small larva, a few days old. Slightly enlarged. (Original.)

fully hardened and mature the young beetle crawls into the mine leading away from the pupal cell and completes this mine to the surface of the tree or log. It then flies away. Mating and egg laying soon follow to provide for another generation.

#### SEASONAL HISTORY.

Probably in the great majority of cases the larva does not change to the pupa until the spring following the season in which the egg is laid, passing the winter either in the larval mine or in the pupal cell. However, pupation may take place in the fall and the winter be passed in this stage, or the adult stage may be reached in the fall and the winter be passed in this form within the pupal cell. The following spring the larvæ which have wintered over transform to pupæ. The pupæ soon transform to adults and the adults emerge and take flight. Likewise, the pupæ which have wintered over transform to adults and emerge. The first to emerge, however, are those individuals which have wintered over as adults. Sometimes a species may have two generations a year, or a partial second generation. In these cases development takes place rapidly after the eggs are laid in the spring, the adult insects of the first generation emerging in late summer or fall, and laying eggs for the second generation. The second generation passes the winter as outlined above. In still other and more rare cases two or more years may be necessary for the complete development of certain species.

#### THE WESTERN LARCH BARK-BORER.

(*Tetropium velutinum* Lec.)

At the present time the western larch bark-borer is quite a serious pest in the Glacier National Park in Montana. In the vicinity of Lake McDonald about 10 per cent of the stand of western larch or tamarack is being killed annually by this bark-borer. Besides larch it attacks fir, Douglas fir, western hemlock, and pine, in the Rocky Mountain and Pacific coast regions.

The eggs are deposited in clusters under overlapping scales of bark (fig. 19, *a*) and the minute larvæ hatching therefrom proceed to the inner bark, where they immediately commence their mines (fig. 19, *b*).

The work of this borer in larch is confined to the bark, though in some of the other host trees mentioned above it sometimes enters the sapwood. The larval mine is irregular and winding in the inner bark. The number of mines is so great as to completely girdle the tree and cut off the sap, thereby causing the death of the tree. Often almost the entire inner layer of bark, or cambium, is destroyed for quite a considerable space upon the trunk (fig. 20, *a*).



The grub (fig. 20, *c*) is elongate and somewhat cylindrical, yellowish white in color, and about 1 inch long when full grown. Its mouth-parts are dark brown to black, and the under side of the body is provided with three pairs of minute legs. It lives in the bark about a year, emerging in the spring or summer as an elongate, brownish to black beetle (fig. 20, *b*), the surface of the body having a velvety appearance. The beetle ranges in length from 9 to 19 mm.<sup>1</sup> The principal time of emergence is May and June. This species attacks either healthy, injured, or felled trees.

The methods of control are preventive. Once a tree is badly infested nothing can be done to save that particular tree. Something can be done, however, to stop the spread of the infestation to other trees. Infested trees should be felled and barked and the bark burned before May 15. Something could also be accomplished by the use of trap trees. As the insect breeds readily in felled trees, a few healthy trees felled in May or June near those infested would attract the beetles which would otherwise deposit their eggs in healthy trees. Later in the season, or before the following spring, the bark should be stripped off the trap trees and burned.

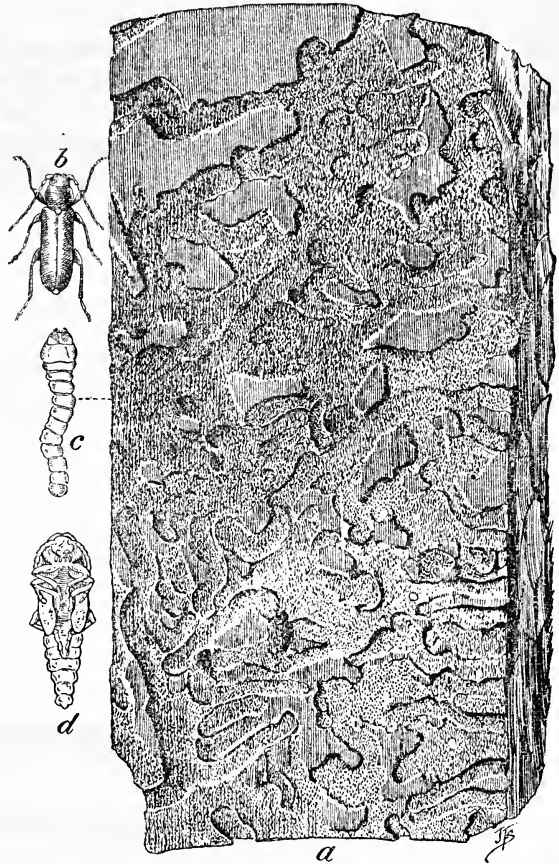


FIG. 20.—Work of the western larch bark-borer (*Tetropium velutinum*). Section of bark of western larch: *a*, Completed larval mines in inner bark; *b*, adult beetle; *c*, larva; *d*, pupa. Insects approximately natural size. (Original.)

<sup>1</sup> 1 mm. =  $\frac{1}{25}$  inch.

## THE SOUTHERN PINE SAWYER.

*(Monohammus titillator* Fab.)

Within recent years the States of the extreme south have suffered severely from cyclones and other windstorms. An immense amount of pine timber has been felled by these storms. In practically every case great damage has been done to the fallen timber by the southern pine sawyer over the entire area covered by the storm. It has been estimated that during the years 1906, 1907, and 1908 the pecuniary loss from this source in the Southern States was over \$6,000,000.<sup>1</sup>

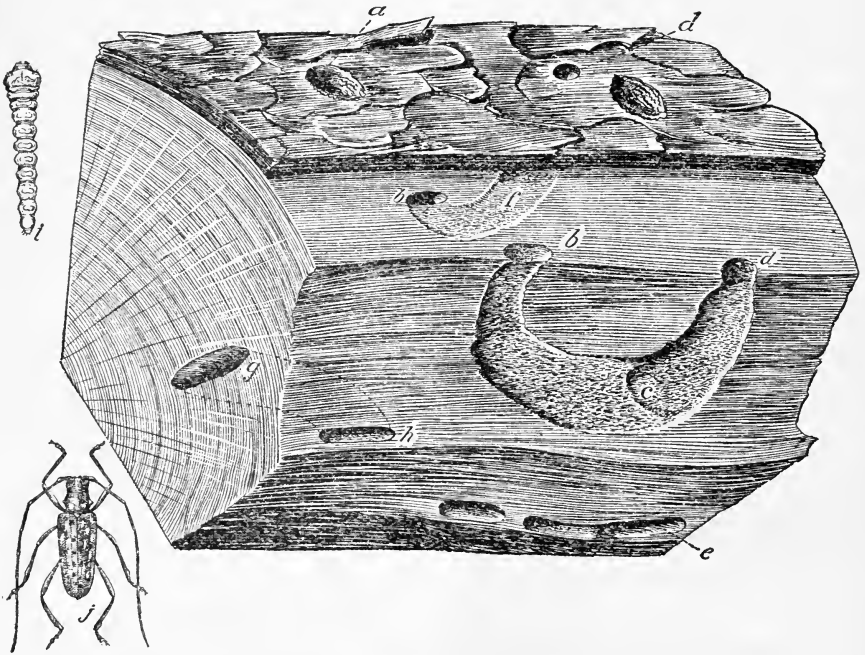


FIG. 21.—Work of the southern pine sawyer (*Monohammus titillator*). Section of trunk of storm-felled longleaf pine, showing: *a*, Egg pit in bark; *b*, entrance hole of larva into wood; *c*, pupal cell; *d*, emergence hole; *e*, *g*, *h*, sections of larval mines; *f*, scored surface of wood, scoring done by larva preparatory to entering wood; *i*, larva; *j*, adult. Insect one-half natural size. (Original.)

This insect never attacks healthy trees, but only those already dead, dying, or felled. The damage to each tree or log is the work of the larvæ or grubs which, after first mining in the bark, mine in and through the sapwood, and even penetrate the heartwood, making large unsightly holes (see fig. 21) which cause the lumber made from this portion of the log to be thrown into the lowest grade, known to the lumberman as "No. 2 common." The larva is an elongate, footless, white grub (see fig. 21, *i*). The size varies considerably in different

<sup>1</sup> U. S. Dept. of Agriculture, Bureau of Entomology, Bul. 58, Part IV, p. 45.

individuals and according to age. The largest at maturity have been found to measure slightly over 60 mm. in length and 9 mm. in breadth at the broadest point. It appears that normally there is one generation of this species per year, with a partial second generation. Thus, a few larvæ hatched from eggs deposited in the spring go through their changes to the adult form and the adults emerge in the fall, while the larger number of the larvæ hatched from eggs deposited in the spring and summer hold over until the following spring, when the adults emerge. The adult (fig. 21, *j*) is an elongate beetle varying from 16 to 31.5 mm. in length and from 5 to 10 mm. in width. The color is a mottled gray and brown. In the male the antennæ ("horns") are very long, often being two or three times the length of the beetle. In the female they are much shorter. The principal time of emergence in the Southern States seems to be March and April.

Injury to felled pine timber by this species may be prevented in two ways. First, by placing infested logs in water while the larvæ are still in the bark and before they have entered the wood; and second, by removing the bark from the logs before the larvæ have entered the wood.

Trees or logs infested by this borer can be readily recognized by the pits (fig. 21, *a*) excavated in the bark by the female preparatory to depositing eggs.

#### THE LOCUST BORER.

(*Cyllene robinia* Forst.)

So important and destructive an enemy of the black or yellow locust has the locust borer become that in certain sections of the country the growing of these trees has been considered unprofitable because of the widespread depredations of the borer. Throughout the Eastern and Middle States scarcely a community where locust trees occur is exempt from this insect. Many trees are

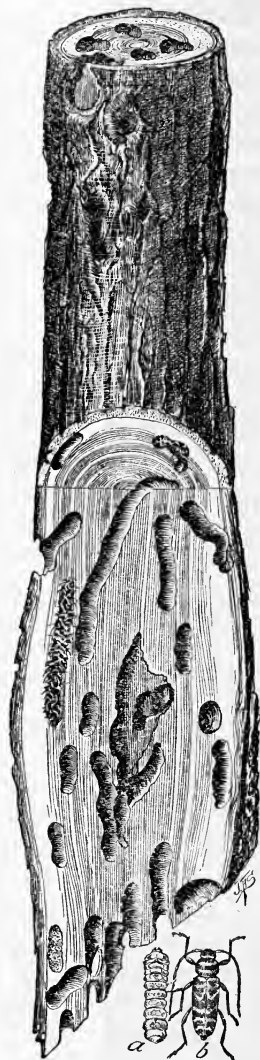


FIG. 22.—Work of the locust borer (*Cyllene robinia*). Section of trunk of dying locust, showing larval mines: *a*, Larva; *b*, adult. Insects natural size. (Original.)

killed outright, and in others the wood is generally reduced in value for commercial purposes.

So far as known, this species confines itself to the black or yellow locust. The borer is an elongate, compact, yellowish-white grub or larva furnished with three pairs of minute legs (fig. 22, *a*). Its first work is done in the inner bark, where it destroys a portion of the vital tissues. Later it enters the wood to feed and pupate. It is here that its most destructive work is done, either by so honeycombing the wood as to cause the death of branches or small trees or by injuring the wood for commercial purposes (fig. 22). The egg from which the borer is hatched is deposited by the adult female in a crevice of bark on the trunk or a branch, between the middle of August and the middle of October. The larva passes the winter in the bark, where it lies dormant in a hibernating cell of its own construction. In the spring (usually about the second week in April in the vicinity of Washington) activity commences again and the borer leaves the hibernating cell to feed on the inner bark and outer wood. In from two weeks to a month it enters the wood, where it continues to feed and later changes successively to pupa and adult (fig. 22, *b*). Adults begin emerging from the trees in August and continue emerging till the last of September, the principal period of emergence being the last half of August and first half of September. The adult is an elongate beetle, the ground color of which is black, with numerous cross-bands of yellow. Within a few hours after emergence copulation takes place and the females begin depositing eggs. There is but one generation a year.

The adults are usually common, feeding on the flowers of goldenrod while this plant is in bloom.

When infested trees are so badly damaged as to be worthless they should be cut down in May and June and burned to kill the broods of larvæ. At this time all such trees can be easily recognized by the boring dust which is thrown out by the larvæ and lodges in forks of trees, in crevices of bark, and on the ground underneath. They can also be recognized by the fading leaves, broken branches, etc. This work should be completed by the time the flowers have all fallen from the trees, or before the earliest varieties of goldenrod begin to show evidences of flowering.

Hibernating larvæ may be killed by spraying the trunks and branches with a strong solution of kerosene emulsion. This method is specially recommended for the protection of small plantations, groves, or shade trees. The work should be done in the fall or winter, not earlier than November 1 and not later than April 1.

Great care should be exercised as to the time of year when locust trees are cut for any purpose in order that the hibernating borers may be destroyed. Except for the purpose of destroying the borers in the



WORK OF THE BLACK-HORNED PINE BORER (*CALLIDIUM ANTENNATUM*).

[Section of spruce rustic work, showing larval mines on surface of wood. *a*, Entrance hole of larva into wood. (Original.)]



wood, cutting should always be done between the 1st of October and the 1st of April and the bark removed, and the tops and thinnings burned. When it is necessary to cut trees between the 1st of May and the middle of September, the tops should be burned and the logs either barked, or submerged in water for a few days before they are shipped or manufactured.<sup>1</sup>

THE PAINTED HICKORY BORER.

(*Cyllene caryæ* Gahan.<sup>2</sup>)

The painted hickory borer is a close relative of the locust borer and one of the commonest and most destructive borers in dead and dying hickory, the larval mines often riddling the sapwood and sometimes the heartwood as well. Besides hickory, it attacks walnut, honey locust, mulberry, and Osage orange, but never attacks the black locust. Its range appears to be coextensive with that of hickory.

The larva is a creamy white, compact grub and has three pairs of legs. The adult so closely resembles the adult of the locust borer (fig. 22, *b*) as to be, to the ordinary eye, indistinguishable from it. The seasonal history, however, is quite different from that of the locust borer. The adults fly and deposit eggs in May and June and do not appear at other seasons of the year. The egg is laid in a crevice of bark, and the young larva hatching therefrom proceeds to the inner bark and soon enters the wood. If a great number of larvæ

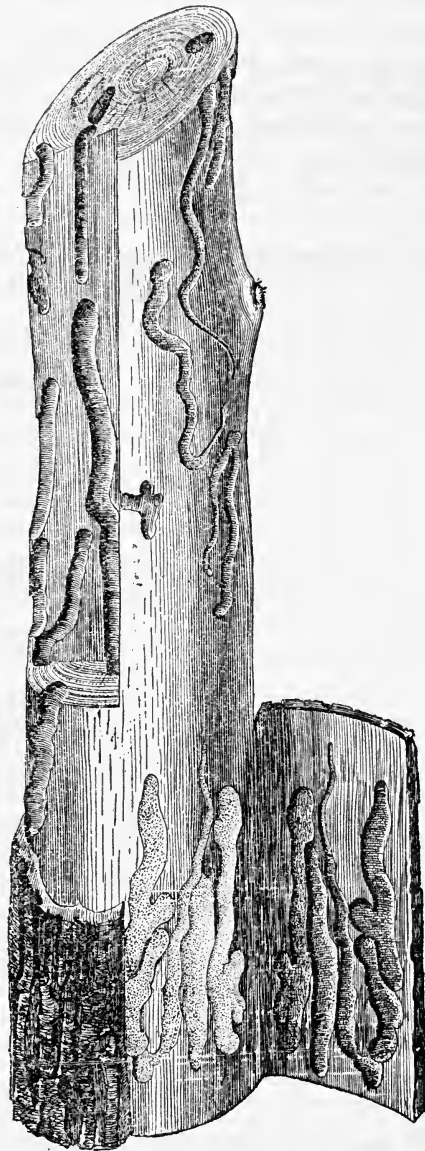


FIG. 23.—Work of the painted hickory borer (*Cyllene caryæ*). Section of hickory log showing larval mines. (Original.)

<sup>1</sup> See U. S. Dept. of Agriculture, Bureau of Entomology, Bul. 58, Part I, and Bul. 58, Part III.

<sup>2</sup> Known for many years under the name of *Cyllene pictus* Drury.

are present in the same piece of wood, the solid wood is often literally honeycombed with their mines (fig. 23). Pupation takes place in the wood and the adult beetle usually emerges in May or June of the year following that in which the egg is laid.

It has been found that hickory cut between August 10 and November 1 usually is not damaged by this borer. Therefore, where much damage occurs from this source, all cutting of green timber should be done as nearly as possible within this period. If it is absolutely necessary to do the cutting in the spring or early summer, the bark should be removed and the tops and useless branches burned.

#### THE BLACK-HORNED PINE-BORER.

(*Callidium antennatum* Newm.)

Injuries by the black-horned pine-borer to the bark or sapwood of dead or dying cedar, juniper, pine, and spruce are common generally over the United States. Often the timbers in rustic houses are found to be infested, and rustic work is especially liable to injury, since the presence of bark is absolutely necessary for the early development of the borer.

When first hatched from the egg the larva feeds exclusively on the inner bark, making an irregular winding mine. Later it also grooves the surface of the wood (Pl. XXIII) in making its mine, thus completely separating the bark from the wood, causing it to become loose and, in many cases, to fall off. As the essential part of rustic work is the bark, this sort of injury to it is quite a serious matter. The larva is an elongate, fleshy, yellowish-white grub, usually about a half inch in length when full grown. After working in the bark until a certain period of development is reached, the larvæ enter the wood and continue their mines there. Usually they do not go deeper than the sapwood, except in small stems or branches, where they may penetrate the heartwood. The larva pupates in the wood. The adult which finally emerges is a medium-sized, robust beetle, 9 to 14 mm. in length, blue to green in color throughout. There appears to be but one generation a year. Adults fly and deposit eggs during the months of April, May, June, and July. The winter is probably passed in the larval stage, the adults emerging the following spring.

As a preventive against injuries by this borer, cedar, juniper, pine, and spruce should be cut in the late summer, fall, or early winter. If cut during the period between January and August, the trees should be barked when felled. In the case of rustic work already in use when found to be infested, some relief may be secured by injecting bisulphid of carbon into holes in the bark through which sawdust-



like borings fall out, and stopping up the holes with putty or some kind of wax. The dropping of the sawdust-like borings from the logs or timbers always indicates the presence of this or a similar kind of borer.

THE CEDAR-TREE BORER.

(*Hylotrupes ligneus* Fab.)

The cedar-tree borer attacks dead and injured Douglas fir, arborvitæ, red cedar, redwood, western hemlock, Engelmann spruce, juniper, alpine fir, giant arborvitæ, white fir, bigtree, and Arizona cypress. In some cases living, healthy trees may be attacked and killed, and in other cases the death and decay of already unhealthy trees may be hastened by this borer. This species also seriously injures the wood of felled trees for commercial purposes and the bark and wood of those used for rustic work. Its occurrence is general over the United States where its host plants occur.

The larva (fig. 24, *b*) is a yellowish-white grub about half an inch in length when mature, tapering from the prothoracic segment to the last three abdominal segments, which are slightly larger than those immediately preceding. The adult (fig. 24, *a*) is a beetle varying from 7 to 16 mm. in length. The elytra or wing covers are sometimes marked with alternate transverse bands of red and black, and sometimes are entirely

black or reddish brown. Apparently there is but one generation a year. The egg is laid in crevices of the bark in spring or summer. The larva hatching from the egg excavates a winding, irregular mine in the inner bark, scoring the wood, later entering the sapwood, and sometimes penetrating to the heartwood (fig. 24). Pupation usually takes place in the sapwood, but sometimes occurs

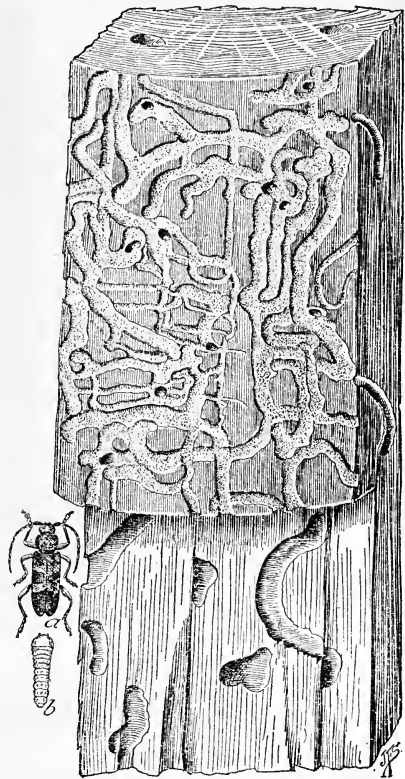


FIG. 24.—Work of the cedar-tree borer (*Hylotrupes ligneus*). Section of Arizona cypress showing larval mines. *a*, Adult; *b*, larva. Insects natural size. (Original.)

in the heartwood or even in the bark. It appears probable that the winter may be passed either in the larval, pupal, or adult stage, the larval stage evidently predominating. The period during which adults emerge is quite extended, apparently from March to September, inclusive, depending considerably on latitude and altitude and on the stage of development reached before hibernation began during the previous winter. The same period represents the time when eggs are deposited for another generation.

The usual preventive measures are recommended, i. e., removing the bark from trees when felled or treating rustic work as recommended for the black-horned pine borer, except those felled in late fall or early winter, which should not be injured by this borer.

#### THE WESTERN CEDAR BARK-BORER.

(*Hylotrupes amethystinus* Lec.)

The western cedar bark-borer is a relative of the preceding, the cedar-tree borer. Unlike the latter, however, its range is considerably restricted. The records of the branch of forest insect investigations, Bureau of Entomology, indicate that it is found only in the Pacific Coast States. It is of considerable economic importance, however, in injuring the bark and wood of recently felled giant arborvitæ and incense cedar.

The larva (fig. 25, *a*) is a large, fleshy, yellowish-white grub, provided with three pairs of feet. The largest larvæ are about 25 mm. long at maturity and about 8 mm. in width at the broadest part of the body, the prothorax. The adult (fig. 25, *b*) is a medium-sized to large, robust beetle, 12 to 23 mm. in length. The prothorax is black to reddish brown. The elytra, or wing-covers, are of a brilliant blue to violet color. The larvæ mine in the inner bark, making broad wind-

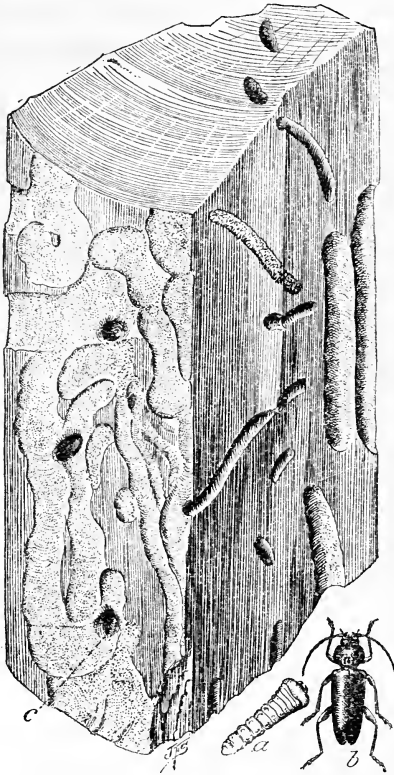


FIG. 25.—Work of the western cedar bark-borer. (*Hylotrupes amethystinus*). Section of incense cedar log, showing larval mines. *a*, Larva; *b*, adult; *c*, entrance hole of larva into wood. Insects slightly reduced from natural size. (Original.)

ing galleries and scoring the surface of the sapwood, sometimes almost entirely separating bark from wood. They finally enter the wood, sometimes mining to the heartwood, where the mine becomes longitudinal. Pupation takes place in either bark or wood, but usually in heartwood. It is probable that there is but one generation a year and that adults emerge and deposit eggs in July, August, and September.

The same recommendations for preventing injury as those given for the cedar-tree borer are applicable to this species.

#### THE BANDED ASH BORER.

(*Neoclytus caprea* Say.)

Numerous complaints have been received by the Bureau of Entomology regarding serious damage to ash lumber by the banded ash borer and closely related species. Of all species concerned, however, this is apparently the most destructive, the larvæ perforating the sapwood with their mines (fig. 26) and greatly depreciating its value, if not entirely ruining it. Besides ash, the borer attacks and lives in mesquite and, rarely, in white oak.

The larva is an elongate, footless, fleshy white grub about an inch in length when mature. The adult is an elongate beetle, 15 to 18 mm. in length. The ground-color is black, with four yellowish-white bands on the elytra or wing-covers and one on the anterior border of the prothorax. The tips of the elytra are yellowish white. The female beetle deposits her eggs on the bark of dying or dead trees or logs. There is but one generation a year. The adults usually emerge and deposit eggs in March, April, or May. The larvæ mine in the bark and sapwood and pupate in the sapwood.

Ash trees cut in the summer, fall, or early winter are less liable to attack from this species than those cut in the spring, but even those cut in the fall are sometimes attacked the following spring. The best way to prevent injury to logs cut during the winter and spring, when the logs are



FIG. 26.—Work of the banded ash borer (*Neoclytus caprea*). Section of ash log showing larval mines. (Original.)

not to be immediately sawed into lumber, is to remove the bark immediately upon felling or between the 1st of March and 1st of June. Placing the logs in water after the larvæ have hatched and before they have entered the wood is also effective.

#### THE RED-HEADED CLYTUS.

(*Neoclytus erythrocephalus* Fab.)

The red-headed clytus is a close relative of the banded ash borer and does considerable damage to the wood of dead and dying ash, as well as to a number of other trees. The list of its host plants includes ash, hornbeam, hickory, maple, sweet gum, chestnut, cypress, hackberry, black walnut, dogwood, black oak, persimmon, peach, locust, sassafras, holly, mesquite, Texas redbud, pine, Kentucky coffee tree, lilac, honeysuckle, and grapevine.

The larva is a slender, white, footless grub of varying length when mature, the average length at this stage being, perhaps, about 15 mm. The adult is a slender beetle, 6 to 16 mm. in length. The head and prothorax are red. The anterior part of the elytra is reddish, shading into dark brown or black posteriorly. The elytra bear four pairs of yellow bands, the first pair being at the extreme base. There is but one generation a year. It appears that eggs may be laid anywhere from March to September. The adult female deposits the egg in a crevice of bark on a dead or dying tree or log. The young larva, hatching from the egg, mines first in the

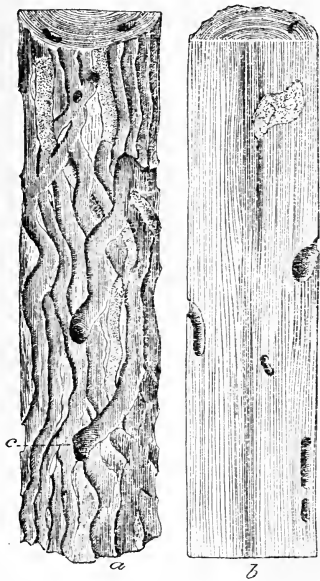


FIG. 27.—Work of the red-headed clytus (*Neoclytus erythrocephalus*) Sections of hickory log showing: *a*, Larval mines on surface of wood; *b*, larval mines in the wood; *c*, entrance hole of larva into wood. (Original.)

inner bark and later continues the mine in the sapwood, thus injuring the wood for commercial purposes (fig. 27). Pupation takes place in the sapwood. The adult emerges from the tree or log the following spring or summer after the egg is laid. This species is common from the District of Columbia to Ohio, and south to Texas.

The same preventive measures as those given for the banded ash borer apply to this species except, it will be noted, that the egg-laying period of this species is much longer than that of the banded ash

borer, so that there is scarcely any season of the year when trees may be cut and left with bark on, without danger of being damaged by this borer.

#### THE OAK PRUNER.

(*Elaphidion villosum* Fab.)

In the oak pruner we have a species which attacks only twigs or small branches on living and injured trees, causing them to break and fall to the ground. If occurring in large numbers it is of considerable economic importance, in retarding the growth of twigs and branches. Besides oak, this species attacks sassafras, black walnut, hackberry, sweet gum, hickory, and maple. Its range extends from Pennsylvania to South Carolina, and as far west as New Mexico.

The larva (fig. 28, *a*) is a very slender white grub about one-half inch in length. The adult is a slender, shining, brown beetle (fig. 28, *b*), 11 to 16 mm. in length, rather sparsely clothed with gray pubescence, each elytron terminating in two spines of about equal length. Adults fly in March, April, May, and June, during which time oviposition takes place upon the twigs or branches.

The young larva, after hatching from the egg, first mines in the inner bark, then enters the wood and girdles the twig or branch by boring around it several times in the same place (fig. 28), leaving the bark and usually some of the wood intact. The larva then mines in the center of the twig beyond the girdle. The twig is usually broken off at the girdle by the wind and falls to the ground, carrying the larva with it. Pupation takes place in the center of the twig. There is apparently one generation a year, the adult usually emerging in March, April, May, or June of the year following that in which the egg is laid.

When this species occurs in large enough numbers to be injurious, the fallen twigs and recently killed twigs still on the trees should be gathered and burned in the fall in order to destroy the larvæ and pupæ in them.

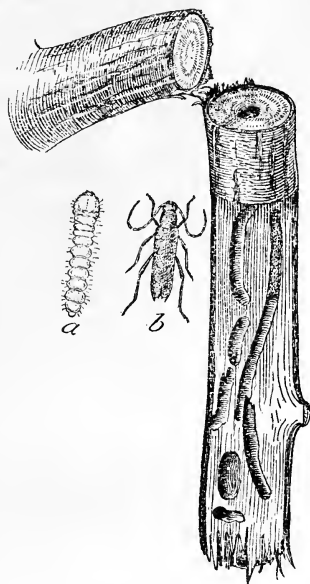


FIG. 28.—Work of the oak pruner (*Elaphidion villosum*). Oak branch which has been pruned, showing larval mines. *a*, Larva; *b*, adult. Insects natural size. (Original.)

## THE HICKORY TWIG-GIRDLER.

*(Oncideres cingulata Say.)*

The work of the hickory twig-girdler, like that of the oak pruner, is confined to the twigs and branches, and is often quite injurious. Only living trees are attacked. The list of host plants includes hickory, basswood, poplar, dogwood, black gum, elm, persimmon, and acacia. The range of this species extends from the eastern United States to Arkansas and Kansas.

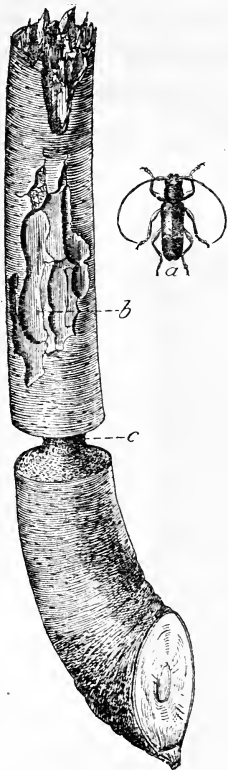


FIG. 29—Work of the hickory twig-girdler (*Oncideres cingulata*). Acacia branch showing girdle, and larval mines in bark and outer wood. Insect natural size. (Original.)

The larva is a footless white grub about half an inch or more in length when mature. The abdominal segments, except the last two, bear minute granules, both above and below. The adult (fig. 29, *a*) is a stout beetle, 12 to 14 mm. in length, dark gray to reddish brown in color. The flight of the adults and the deposition of eggs usually occur in August or September. The adult female punctures the branch or twig and deposits an egg in each puncture. She then gnaws off the bark and outer wood at a point on the branch below where the eggs are laid, completely circling the limb and causing that portion of it beyond the girdle to die (fig. 29). The eggs hatch and the larvæ, after mining in the inner bark (fig. 29, *b*), bore to the center of the branch, where pupation takes place in the larval mine, little if any protective device in the way of a pupal chamber being made. Probably most of the infested twigs and branches fall to the ground before the larvæ complete their development, though some do not. It has been found that in the infested branches which do not fall the larvæ seldom complete their development to the adult stage unless the branches are in a shaded position. Likewise, few adults are produced from

branches which are freely exposed to the sun after falling. This insect reaches its best development in shaded twigs or branches, or those partially covered by leaves or vegetation. In North Carolina the larvæ begin to pupate about August 1 of the year following that in which the eggs were laid, most of the adults probably emerging in September. The winter is therefore passed in the larval state.

The work of the insect is not confined to the large trees, but straight young seedlings from 4 to 10 feet high are sometimes attacked and the entire top taken off, resulting in the removal of about 2 feet of the new growth, usually nearly two years' increment. The adult beetle apparently injures the smaller twigs by feeding upon the bark without depositing eggs in them.

Where this species occurs in destructive numbers it is advisable to collect and burn the pruned twigs and branches. This should be done several times between October 1 and August 1 of the following year—once just before the leaves fall, once early in the spring before vegetation starts, and again in the summer during June or July. The twigs which first fall are quite apt to be almost hidden by fallen leaves and quite difficult to find in the spring.

#### SUMMARY.

In general, roundheaded borers are elongate, fleshy, yellowish-white grubs, which hatch from eggs deposited by the parent beetles in or upon the bark or wood of the host plant. The grubs finally change to pupæ and these in turn change to adults or beetles. The young adults in time emerge from the host and deposit eggs in or upon other host plants; and so the life cycle goes on. Usually there is but one generation a year, but in some species there may be two generations a year, and in other species it may take longer than a year for a single generation to develop.

Great damage is done to living and felled trees, and to standing dead trees, by this class of borers. In some cases the borers confine themselves to the bark, while in others they enter the wood. The remedy in each case depends upon the habits and character of work of the species under consideration.

The western larch bark-borer attacks perfectly healthy western larches, making winding, irregular galleries in the inner bark, thus cutting off the flow of sap and killing the trees. The methods of control are preventive. No attempt is made to save a tree which has once become badly infested. After becoming infested, trees should be felled and barked and the bark burned before the following May 15. A few healthy trees felled in May or June, near those infested, should attract the beetles which would otherwise deposit eggs in healthy trees. Before the following spring the bark should be stripped from these trap trees and burned.

The southern pine sawyer is very destructive to felled pine timber in the Southern States, making large, unsightly holes in the sapwood and greatly reducing in value a considerable percentage of each log infested. Injury by this species may be prevented in two ways. First, by placing infested logs in water while the larvæ are

still in the bark and before they have entered the wood; and second, by removing the bark from the logs before the larvæ have entered the wood.

The locust borer is a serious and destructive enemy of the black or yellow locust. Its first work is in the inner bark. Later it enters the wood, where its most destructive work is done, either by so honey-combing the wood as to cause the death of branches or small trees, or by injuring the wood for commercial purposes. Hibernating larvæ may be killed by spraying the trunks and branches with a strong solution of kerosene emulsion. Except for the purpose of destroying the borers in the wood, cutting should always be done between October 1 and April 1, the bark removed, and the tops and thinnings burned. When it is necessary to cut trees between May 1 and the middle of September the tops should be burned and the logs either barked or submerged in water for a few days before they are shipped or manufactured.

The painted hickory borer attacks dead and dying hickory, walnut, honey locust, mulberry, and Osage orange, the larval mines often riddling the sapwood and sometimes the heartwood as well. To prevent the spread of this species, all cutting of green timber should be done between August 10 and November 1. Timber which must be cut in spring or early summer should have the bark removed and the tops and useless branches burned.

The black-horned pine-borer is an enemy of dead or dying cedar, juniper, pine, and spruce. Rustic work is specially liable to injury from this source. As a preventive against injuries by this species, cedar, juniper, pine, and spruce should be cut in late summer, fall, or early winter. If cut between January and August the trees should be barked when felled. In the case of injuries to rustic work, an injection of bisulphid of carbon and the plugging up of the holes with wax or putty is recommended.

The cedar-tree borer attacks dead and injured Douglas fir, arborvitæ, red cedar, redwood, western hemlock, Engelmann spruce, juniper, alpine fir, giant arborvitæ, white fir, bigtree, and Arizona cypress. Like the black-horned pine-borer, it is injurious to rustic work. The usual preventive measures are recommended, i. e., removing the bark from trees when felled, or treating rustic work as recommended for the black-horned pine-borer.





